FINAL REPORT

UPDATE EXISTING EEAP

FORT CARSON
COLORADO SPRINGS, COLORADO

EXECUTIVE SUMMARY
EEAP
ECIP UPDATES
FORT CARSON, CO
JULY 1993

Prepared for

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, OMAHA DISTRICT
OMAHA, NEBRASKA

Under

CONTRACT DACA45-91-D-0009
EMC No. 2102-001

July 1993

By

E M C ENGINEERS, INC.
2750 S. Wadsworth Blvd., Suite C-200
Denver, Colorado 80227
303/988-2951

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited. Distribution A. Approved for public release.

Marie Wakefield,
Librarian Engineering

This report has been prepared at the request of the client, and the observations, conclusions, and recommendations contained herein constitute the opinions of E M C Engineers, Inc. In preparing this report, EMC has relied on some information supplied by the client, the client's employees, and others which we gratefully acknowledge. Because no warranties were given with this source of information, E M C Engineers, Inc. cannot make certification or give assurances except as explicitly defined in this report.

TABLE OF CONTENTS

TABLE OF CONTENTS (Concluded)

APPENDICES

LIST OF TABLES

LIST OF ABBREVIATIONS

AHU	-	air handling unit
AIRR	-	adjusted internal rate of return
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
Bldg	-	Building
cfm	-	cubic feet per minute
EA	-	each
ECIP	-	Energy Conservation Investment Program: An element of the Military Construction Army funding authority specifically set aside for energy conservation projects that meet specified economic criteria.
ECO	-	Energy Conservation Opportunity
EMC	-	E M C Engineers, Inc.
F	-	Fahrenheit
ft	-	foot, feet
ft^2	-	square feet
ft^3	-	cubic feet
FY	-	the federal fiscal year
hr	-	hour(s)
H&V	-	heating and ventilating
HVAC	-	heating, ventilating, and air conditioning
Investmt	-	investment
kcf	-	thousands of cubic feet
kW	-	kilowatt, one thousand watts
kWh	-	kilowatt-hour, one thousand watthours
LCCA	-	Life Cycle Cost Analysis
MBtu	-	British thermal units (million)
No.	-	number
SF	-	square feet
SIR	-	Savings-to-Investment Ratio: Total life cycle benefits divided by 90% of the differential investment cost.
SPB	-	simple payback: The project investment cost divided by the sum of the annual energy and maintenance cost savings

UCS	-	utility control system: a computer-based system including Direct Digital Controls used for the control of building conditioning equipment and utility systems
U.S.	-	United States
U-value	-	A coefficient expressing the thermal conductance of a composite structure in Btu per (sq ft) (hour) (degrees F temperature difference); Btu/(ft^2 x hr x °F).
W	-	watt(s)
yr	-	year(s)

EXECUTIVE SUMMARY

GENERAL

This study reevaluates three Energy Conservation Opportunities (ECOs) from a 1985 study, evaluates the application of the Conserval Solarwall active solar system on five buildings, and estimates the cost of repair to heating and cooling equipment temperature controls on 82 buildings.

ECO EVALUATIONS

Certain HVAC control system ECOs were studied in 1985 by Forster-Morrell Engineering Associates, Inc, and qualified at that time for implementation under the Energy Conservation Investment Program (ECIP). However, funding for ECIP projects was discontinued before the projects could be implemented. Now that the funding has been restored, it is necessary to requalify the ECOs using current energy prices and current ECIP guidance for life cycle cost analysis. This was done in this study of the following ECOs:

- ECO 13: Replace standard motors with high efficiency motors.
- ECO 14: Install night setback thermostats.
- ECO 16: Install dry bulb economizers on air handling units.
- ECO 19: Install automatic thermostats on steam radiators.

The buildings designated for reevaluation of the ECOs are presented in Table ES-1 below.

TABLE ES-1
BUILDINGS DESIGNATED FOR ECO EVALUATIONS

ECO NO.	Designated Buildings
13	P-1853, P-1950. P-1951, P-1952, P-1953, P-1954, P-2050, P-2051, P-2052, P-2054, P-2060, P-2070, P-2071, P-2072, P-2073, P-2074, P-2150, P-2151, P-2152, P-2153, P-2154, P-2160, P-2250, P-2251, P-2252, P-2253, P-2254, P-2350, P-2352, P-2450, P-2451, P-2452, P-2453, P-2454, P-2700, P-8000, P-8030, P-8142
14	P-1007, P-1955, P-1956, P-2055, P-2056, P-2155, P-2156, P-2700
16	P-1850, P-2359
19	S-6220, S-6221, S-6222, S-6223, S-6224, S-6233, S-6236, S-6237, S-6243, S-6230, S-6231, S-6234, S-6235, S-6240, S-6241, S-6244, S-6252, S-6253, S-6254, S-6255

The results of the evaluations are presented in Table ES-2 below.

TABLE ES-2
PRIORITIZED ECO SUMMARY

ECO No.	Electric Energy Savings (MBtu/yr)	Gas Energy Savings (MBtu/yr)	Investmt Cost ($)	Electric Cost Savings ($/yr)	Gas Cost Savings ($/yr)	SPB (yrs)	SIR	AIRR %
14	22	2,631	5,974	377	9,145	0.6	22.4	28.0
16	0	308	8,697	0	1,070	8.1	2.3	8.4
13	846	0	92,418	8,944	0	7.4	2.0	7.7
19	0	9,875	263,997	0	34,325	7.7	1.8	8.3
ALL ECOs	868	12,814	371,086	9,104	53,645	6.5	2.7	9.4

SOLAR WALL ANALYSIS

A proprietary application of active solar energy technology to industrial buildings has been developed by Conserval Engineering, Inc. of Canada. The Conserval Solarwall is presently under consideration for installation at the AVUM hangar at Butts Army Air field. The application of the technology was evaluated for Buildings P-1160, P-2357, P-8030, P-8142 and P-8300 with unfavorable results. The application of the Conserval Solarwall is not cost effective at any of the five buildings and is not recommended.

TABLE ES-3
SOLARWALL ANALYSIS SUMMARY

Bldg No.	Gas Energy Savings (MBtu/yr)	First Cost ($)	Gas Cost Savings ($/yr)	SPB	SIR	AIRR %
P-2359	126	9,354	626	14.9	0.6	-0.6
P-8300	325	38,835	1,617	24.0	0.4	-5.2
P-8142	231	30,197	1,146	26.3	0.4	-6.1
P-1160	108	19,867	535	37.1	0.3	-9.2
P-8030	957	253,181	4,727	54.0	0.2	-12.5

HEATING AND COOLING EQUIPMENT REPAIRS

The existing pneumatic and electric temperature controls are scheduled to be replaced with Direct Digital Controls (DDC) in a number of buildings at Fort Carson. The heating and cooling coil control valves and modulating air flow dampers will remain either pneumatically or electrically actuated as currently configured. In order for the new DDC systems to function properly, it is necessary for the valves and dampers and their actuators to be in good operating condition with substantial remaining service life. These components were inspected for condition, and necessary repair and replacement actions were identified for each of the 82 buildings listed in Table ES-4.

In general the heating and cooling equipment is well maintained, but most of the heating and cooling coil control valves and valve actuators are near the end of their expected service lives. If the UCS project proceeds to construction, the repairs and replacements identified in this report should be made at the time of construction.

Table ES-5 lists the cost of repair and replacement for each of the 18 groups of buildings identified in Table ES-4.

TABLE ES-4
BUILDINGS INSPECTED FOR EQUIPMENT DISCREPANCIES

Group No.	Building Nos.
1	P-1950, P-2070, P-2153, P-2250
2	P-1951, P-1952, P-1953, P-1954, P-2050, P-2051, P-2052, P-2054, P-2078, P-2071, P-2072, P-2073, P-2074, P-2150, P-2151, P-2152, P-2154, P-2251, P-2252, P-2253, P-2254, P-2450, P-2451, P-2452, P-2453, P-2454
3	P-1007, P-1150
4	P-1118, P-1217, P-1218, P-1219, P-1220, P-1363, P-1364, P-1365, P-1366, P-1367, P-1664, P-1665, P-1666, P-1667
5	P-1227
6	P-1446
7	P-1526
8	P-1528
9	P-1855
10	P-1864
11	P-1955, P-1956, P-2055, P-2056, P-2155, P-2156
12	P-1957, P-1958, P-2057, P-2058, P-2157, P-2158, P-2257, P-2258, P-2457, P-2458, P-2557, P-2558
13	P-1853, P-2060, P-2160, P-2350, P-2352, P-2700
14	P-2357
15	P-1850, P-2359
16	P-8000
17	P-8030
18	P-8142

TABLE ES-5
EQUIPMENT REPAIR COST SUMMARY

Bldg Group No.	Labor Cost ($)	Material Cost ($)	Total Cost ($)
1	1,720	7,824	9,545
2	10,513	88,112	98,624
3	956	6,385	7,341
4	11,507	60,834	72,341
5	478	3,193	3,670
6	707	7,585	8,293
7	765	4,687	5,451
8	0	0	0
9	1,013	6,401	7,414
10	1,032	10,869	11,902
11	1,720	10,623	12,343
12	3,441	15,337	18,778
13	2,485	13,814	16,299
14	2,370	15,547	17,918
15	1,109	8,682	9,791
16	1,319	9,811	11,130
17	593	3,274	3,866
18	745	4,784	5,530
Total	42,472	277,764	320,236

RECOMMENDATIONS

ECO 13 - Motor Replacement: Replacing standard drive motors with high efficiency motors is cost effective, as shown in Table ES-2 on page ES-2. The $92,418 investment cost has an AIRR of 7.7% and an SIR of 4.1, which gives this project a medium priority. The motors should be replaced as soon as funding permits. As a result of the study, it is recommended that a motor replacement policy be established at Fort Carson to routinely replace all failed standard motors with high efficiency motors. This will reduce the electrical demand, save energy, increase motor service life, and lower maintenance costs over the life of the motors.

ECO 14 - Night Setback Thermostats: This ECO is one of the most cost effective ways of reducing energy consumption. The investment cost is only $5,974 and the AIRR is 28%. The payback is just one heating season. It is recommended for implementation with a high priority.

ECO 16 - Dry Bulb Economizers: The investment cost is $8,697 with a payback in 8.1 years, an SIR of 2.3, and an AIRR of 8.4%. Only two buildings are included in this ECO. It is recommended for implementation with a medium priority.

ECO 19 - Automatic Radiator Control Valves: This ECO is the least cost effective of the 4 ECOs evaluated, primarily because of the very large number of radiators in the 17 buildings in the old hospital complex. There are a total of 1,824 radiators to be retrofitted with steam control valves and wall-mounted thermostats. The payback for the $263,977 investment cost is 7.7 years, with an AIRR of 8.3%. This ECO is recommended, with a medium priority, for implementation.

The total investment cost of all qualifying ECOs is $371,086 which exceeds the $300,000 ECIP project threshold limit. Therefore, it is possible to submit the 4 qualifying ECOs as an ECIP project without combining them with other energy projects at Fort Carson. However, the total project SPB of 6.5 years is marginally competitive. It is recommended that cost effective energy conservation projects already identified in other projects, such as for Evans Army Hospital, be combined with those from this study into a single ECIP project to reduce the SPB. This would improve the probability of obtaining ECIP funding. For such an ECIP project it would be necessary to reevaluate the economic effectiveness of the Evans Hospital ECOs using the current ECIP guidance. Program documentation would have to be prepared for the ECIP project.

Conserval Solarwall: This proprietary technology appears to make a lot of sense for new construction of industrial buildings with high ventilation rates and long operating schedules, but it is not cost effective for any of the 5 buildings evaluated, and is not recommended.

Heating and Cooling Equipment Repairs: This evaluation does not involve energy savings, but rather identifies the temperature control elements that should be replaced on 82 buildings in the event a UCS is installed to control the buildings as planned. The cost of $320,236 is

in the event a UCS is installed to control the buildings as planned. The cost of $320,236 is necessary in order to insure the new Direct Digital Controls will be effective in controlling space temperatures.

The heating and cooling coil control valves will have to replaced sometime in the next few years because they are near the end of the expected service life. Replacing them all as a single project will improve space temperature control and reduce maintenance costs over the next several years. The replacement should be done as a single project in the event the UCS project proceeds to construction. Otherwise, the control components may be replaced at the time of failure.